CLAIMS

What is claimed is:

1. A method for optically converting wavelengths in a multi-wavelength system having W wavelength channels, wherein $W = 2^N$, the method comprising the steps of:

selectively directing a received frequency channel corresponding to a respective wavelength channel based upon a predetermined frequency mapping; and

shifting the frequency of the selectively directed frequency channel at least once by an amount defined by $\pm 2^i \Delta f$, wherein Δf is a frequency spacing between adjacent frequency channels, and $i = 0, 1, \ldots N-1$.

2. The method as defined in claim 1, wherein wavelength channel ordering is preserved by only shifting the frequency of the selectively directed frequency channel to a higher frequency.

3. The method as defined in claim 2, wherein the shifting of the frequency of the selectively directed frequency channel is constrained such that the frequency of the selectively directed frequency channel is shifted at least once by an amount defined by $+2^{N-1-i}\Delta f$.

4. The method as defined in claim 3, wherein the shifting of the frequency of the selectively directed frequency channel is further constrained such that the frequency of the selectively directed frequency channel is shifted at least once by an amount defined by $+2^{N-\lfloor \log \kappa \rfloor - 1-i}\kappa\Delta f$, wherein κ is an integer and $i = 0, \ldots, N-1-\lfloor \log_2 \kappa \rfloor$.

5. The method as defined in claim 4, wherein the amount by which the frequency of the selectively directed frequency channel is shifted decreases as the number of times the frequency of the selectively directed frequency channel is shifted increases.

6. The method as defined in claim 1, wherein wavelength channel ordering is preserved by only shifting the frequency of the selectively directed frequency channel to a lower frequency.

7. The method as defined in claim 6, wherein the shifting of the frequency of the selectively directed frequency channel is constrained such that the frequency of the selectively directed frequency channel is shifted at least once by an amount defined by $-2^i\Delta f$.

8. The method as defined in claim 7, wherein the shifting of the frequency of the selectively directed frequency channel is further constrained such that the frequency of the selectively directed frequency channel is shifted at least once by an amount defined by $-2^i\kappa\Delta f$, wherein κ is an integer and $i=0,\ldots,N-1-\lfloor\log_2\kappa\rfloor$.

9. The method as defined in claim 8, wherein the amount by which the frequency of the selectively directed frequency channel is shifted decreases as the number of times the frequency of the selectively directed frequency channel is shifted increases.

10. An apparatus for optically converting wavelengths in a multi-wavelength system having W wavelength channels, wherein $W = 2^N$, the apparatus comprising:

at least one switching device for selectively directing a received frequency channel corresponding to a respective wavelength channel based upon a predetermined frequency mapping; and

at least one frequency shifter for shifting the frequency of the selectively directed frequency channel at least once by an amount defined by $\pm 2^i \Delta f$, wherein Δf is a frequency spacing between adjacent frequency channels, and $i = 0, 1, \ldots N-1$.

11. The apparatus as defined in claim 10, wherein wavelength channel ordering is preserved by only shifting the frequency of the selectively directed frequency channel to a higher frequency.

12. The apparatus as defined in claim 11, wherein the shifting of the frequency of the selectively directed frequency channel is constrained such that the frequency of the selectively directed frequency channel is shifted at least once by an amount defined by $+2^{N-1-i}\Delta f$.

13. The apparatus as defined in claim 12, wherein the shifting of the frequency of the selectively directed frequency channel is further constrained such that the frequency of the selectively directed frequency channel is shifted at least once by an amount defined by $+2^{N-\lfloor \log \kappa \rfloor - 1 - i}\kappa\Delta f$, wherein κ is an integer and $i = 0, \ldots, N-1-\lfloor \log_2 \kappa \rfloor$.

14. The apparatus as defined in claim 13, wherein the amount by which the frequency of the selectively directed frequency channel is shifted decreases as the number of times the frequency of the selectively directed frequency channel is shifted increases.

15. The method as defined in claim 10, wherein wavelength channel ordering is preserved by only shifting the frequency of the selectively directed frequency channel to a lower frequency.

16. The apparatus as defined in claim 15, wherein the shifting of the frequency of the selectively directed frequency channel is constrained such that the frequency of the selectively directed frequency channel is shifted at least once by an amount defined by $-2^{i}\Delta f$.

17. The apparatus as defined in claim 16, wherein the shifting of the frequency of the selectively directed frequency channel is further constrained such that the frequency of the selectively directed frequency channel is shifted at least once by an amount defined by $-2^{i}\kappa\Delta f$, wherein κ is an integer and $i = 0,\ldots,N-1-\lfloor \log_2 \kappa \rfloor$.

18. The apparatus as defined in claim 17, wherein the amount by which the frequency of the selectively directed frequency channel is shifted decreases as the number of times the frequency of the selectively directed frequency channel is shifted increases.